EARLY DETECTION OF HEART ACTION IN THE FETUS
AND DETERMINATION OF PLACENTA POSITION WITH
THE DOPPLER ULTRASONIC METHOD

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One of the most important problems of modern obstetrics is the prenatal care of the fetus; in accomplishing this a determination of the intrauterine status is of great value. The principal indication of the condition of a fetus is its heart action. A determination of a heartbeat at an early stage of a pregnancy is an important diagnostic test, especially when there are bloody discharges from the genital passages of a pregnant woman, a suspicion of an undeveloped pregnancy, or a cystic accumulation, and also when making a differential diagnosis between a pregnancy and a fast-growing tumor of the uterus.

Recently electrocardiography and phonocardiography have become commonplace in obstetrical practice in examining the heart action of a fetus; these permit the heartbeat to be detected at the 18th to 20th week of a pregnancy, and in rare cases between the 14th and 15th weeks.

Along with these the ultrasonic method is employed, thus making it possible to determine heart action in a fetus at an early stage of pregnancy. Compared to the electrocardiographic method it gives simpler information—a record of the heartbeat. To answer the question of whether a fetus is alive or dead under a variety of pathologies during early pregnancies the ultrasonic method is quicker and simpler.

The use of the Doppler effect for the examination of a fetus' heart has been described in [1-4].

This method has been employed in our country by V. I. Demidov and A. A. Aristov to detect a fetal heartbeat at an early stage of pregnancy and to locate the position of the placenta [5].

By means of clinical and experimental work [6-8] it has been established that the ultrasonic method, when used for diagnostic and therapeutic purposes, is harmless to both fetus and mother.*

The objective of the present article was to establish the earliest stages at which a fetal heartbeat can be determined, to study the possibilities of ultrasonic apparatus based on the Doppler effect in establishing whether a fetus is alive or dead under a variety of pathologies, to make observations at an early stage of pregnancy (threat of a miscarriage or suspected undeveloped pregnancy), to determine the rate of a fetal heartbeat at an early stage of pregnancy, and also to determine the position of the placenta.

The Doplon-205 (with a power of 12 mW/cm² at a frequency of 2MHz) and the type FM-2 (with a power of 5 mW/cm² at a frequency of 2MHz) made by the Sonicaid Company (England) were the ultrasonic apparatuses employed.

For the detection of fetal heart action 272 women who were between 7 and 20 weeks pregnant were examined. It was found that 109 out of 226 women having a normal pregnancy were between 7 and 9 weeks pregnant. *Editor's note: In the newspaper "Kiodo Tsusin" for July 11, 1972 it was reported that the Association of Japanese Gynecologists and Obstetricians had published in the journal "Maternity Welfare" a warning about the danger of employing modern ultrasonic diagnostic instruments during the first three months of a pregnancy, and recommended that its use be restricted in the later stages. The use of ultrasonic instruments to detect a fetal heartbeat gained widespread use in 1964. Dr. Tetsuya (University of Hokkaido) pointed out that the use of these instruments might cause deformity of a fetus. Experiments were performed on 51 mice at an early stage of pregnancy; three of these mice bore offspring without a brain.


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pregnant, and fetal heart action was found in 33 of them. Of 75 women who were between 10 and 12 weeks pregnant the ultrasonic examination gave positive results on 60. Fetal heart action was established in all 42 women who were between 13 and 20 weeks pregnant.

According to our data the rate of the fetal heartbeat at an early stage of pregnancy is usually between 140 and 160 per minute, which is somewhat greater than at the end of a pregnancy.

We employed the ultrasonic Doppler method to determine whether a fetus was alive or dead for women who were in an infirmary with various pathologies of the early stage of a pregnancy. The examination was performed after the 12th week of a pregnancy, i.e., after the organogenesis of the fetus was, for the most part, completed and the ultrasonic method gave rather accurate information regarding the vitality of the fetus.

Forty-two pregnant women were examined for a suspected undeveloped pregnancy and a threat of a miscarriage during the 13- to 20-week period. No heartbeat was found with the ultrasonic method in 5 of those examined. After 1 to 3 days a spontaneous miscarriage took place. Further clinical observation of the remaining 37 pregnant women confirmed the developing pregnancy.

The Doppler ultrasonic method was used for a differential diagnosis between a pregnancy and a fast-growing tumor on 11 women. In 7 of them the heart action of a developing fetus was detected. Repeated examinations of 4 women suggested that there was a fast-growing uterine tumor which was later confirmed clinically.

In order to localize a placenta by the ultrasonic method 78 women were examined who had been pregnant between 30 and 42 weeks. A check was made at the time of a Caesarian section and by a manual inspection of the cavity walls in the postnatal uterus.

When placentas are located on the front wall of the uterus in the lower uterine segment, the characteristic sounds of a functioning placenta are heard which are synchronized with the rhythm of the fetal heartbeat. A diagnosis of a placenta on the rear wall of the uterus was established by a process of elimination.

An erroneous diagnosis was made in 6 cases. In 2 of 5 cases no diagnosis of the placental presentation could be made. For 3 women the location of the placenta was erroneously diagnosed as being on the front wall of the uterus (when checked it was on the rear wall). In one case a placenta on the front wall was not revealed (the check showed it to be attached to a scar on the uterus from a previous upper segment Caesarian section).

Our observations indicated that it is possible to detect fetal heartbeats and to determine the placental position regardless of the examinee's age, the number of previous pregnancies, and their result.

The experience in using the Dopton-205 and the type FM-2 apparatuses has demonstrated that for the further development of ultrasonic diagnostic apparatus of a similar sort it is advisable to limit the level of the very strong signals that occur when the ultrasonic transducer is applied to the integuments of the examinee's abdominal wall. These signals are manifested by a strong crackling as the transducer is shifted over the integuments.

In order to distinguish the difference between the sound of the placenta and the fetal heartbeat, it would be desirable to develop amplifiers and a system of audio filters that would permit a clearer distinction to be made between the sounds emitted by the placenta, the umbilical cord, and the fetal heartbeat. Making it easier to recognize the sound of the placenta as we have assumed will allow the use of ultrasonic transducers having different directional characteristics.

We believe it very desirable to develop an ultrasonic diagnostic apparatus that would make it possible to obtain an early diagnosis of pregnancy and to follow the status of the fetal heart action in labor; i.e., the functional potentialities of the Dopton-205 and the type FM-2 should be combined in a single apparatus. Since such apparatus might be used under a variety of conditions such as in female consulting, prenatal and maternity wards, as well as other places, it is very important that it should be transportable and portable.

**CONCLUSIONS**

1. An ultrasonic examination with apparatus based on the Doppler effect will under certain conditions make it possible to detect the fetal heartbeat beginning with the 7th to 8th week of pregnancy. When a pregnancy is over 13 weeks, the life or death of a fetus is established with certainty.